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Recognizing and Avoiding Plagiarism

## What is plagiarism?

Plagiarism is the use of someone else's ideas, results, equipment design, visuals, wording, or even sentence structure as if they were your own.

Plagiarism can be intentional:

- You use someone's ideas or results without citing the source;
- You copy something word for word without using quotation marks, even though you cite the source; or
- You use all or part of a visual without crediting the source.

Or it can be accidental:

- You don't realize what is considered plagiarism in the United States;
- You can't think of a better way to say it and so copy sentences, phrases, or even sentence structure from the original without using quotation marks;
- When you took notes, you didn't put exact wording in quotation marks and now you plagiarize without realizing it.

## Why is it important to avoid plagiarism?

In the United States, plagiarism is considered academic misconduct, and you are expected to avoid plagiarism, either intentional or accidental.

Plagiarized work can result in a failing course grade, expulsion, rejection of a paper submitted for publication, denial of an advanced degree, or loss of job. It is increasingly serious now that the Internet has made plagiarism easier than ever before.

## How can you avoid plagiarizing?

For each source you read, use a Template for Taking Notes such as the one on the Cain Project web site: http://www.owlnet.rice.edu/~cainproj. As you

enter the information, proofread for completeness and accuracy. As you take notes, put quotation marks around any wording that you copy directly from the source so that later you can put it into your own words and won't accidentally plagiarize.

If you copy something word for word, put quotation marks around it and cite it: (Jones 2005). If you paraphrase by putting ideas into your own words, cite the source of the ideas: (Jones 2005). If you copy a Figure or Table, cite it at the end of the caption and inside the period: (Jones 2005). If you adapt a Figure or Table or use only part of it, cite it at the end of the caption: (Adapted from Jones 2005). Put the complete bibliographic reference for all citations in the Bibliography (or Works Cited).

**Practice paraphrasing (putting someone else's ideas into your own words) because it's often difficult to do.** Avoid the temptation of paraphrasing too many details. Focus on the main idea or evidence that you need to cite. Once you have determined what you need to paraphrase, reread the source and then cover it up. Write the main idea from memory and then check to verify that you haven't used exact wording or sentence structure. Simply changing the verb tense or substituting one adverb for another, but leaving the sentence structure essentially the same, is still considered to be plagiarism.

If you simply cannot figure out a different way of saying it, use quotation marks to indicate that you are quoting exactly. [Because few writers in science or engineering use quotations, generally preferring paraphrases, paraphrasing is a skill you must learn in those fields. In contrast, writers in the humanities often use quotations to illustrate key points, but they also paraphrase when exact wording is not essential.]

Always cite your source, whether for text, visuals, or ideas. If you cannot remember the source, you can't use the information. Put citations in as you write your first draft so that you don't have to go back later when identifying the source may be difficult.

In your text, make clear what the source is. Generally, it is a good idea to identify an author by name rather than by referring to a number in your bibliography, though this practice varies somewhat by field or by journal. In

any case, try not use a reference number as a part of speech. Do not, for example, write that "[10] gives more compelling evidence than [98] provides." Think of how time consuming it is for a reader to have to keep flipping to the bibliography to see who has said what. It would be preferable to write "Johnson (10) gives more compelling evidence than Dickerson (98) provides." And then move to the evidence, clearly identifying the references as you discuss the evidence each author gives. [Whether you use square brackets or parentheses depends on the field or journal.]

## Examples of citation within the text

**CONFUSING:** [10] and [15] were the next to apply this algorithm to new genetic sequences.

**CONFUSING:** The first big improvement came in the work of [10].

**CLEAR:** Koninsky et al. and Rebert et al. were the next to apply this algorithm to new genetic sequences (10, 15).

**CLEAR:** Koninsky et al. (10) and Rebert et al. (15) were the next to apply this algorithm to new genetic sequences.

**CLEAR:** Smith and Wesson (2001) were the next to apply this algorithm to new genetic sequences.

**CLEAR:** Research teams then began to apply this algorithm to new genetic sequences (Smith and Wesson 2001).

CLEAR: Research teams then began to apply this algorithm to new genetic sequences. (See, for example, Smith and Wesson 2001 and Rebert et al. 2004.)

**RIGHT, but LESS CLEAR:** Research teams then began to apply this algorithm to new genetic sequences. (See, e.g., 10, 15, and 22.)

For suggestions on how to avoid plagiarism and cite information, see *Diana Hacker's The Bedford Handbook,* 7th ed. (2006), pp. 572-579; 698-790. She

includes extensive examples of APA and Chicago style guides. I suggest, too, that you check the Web site for the book: www.dianahacker.com/bedhandbook for further information. Or go to other Web Site sources: Check Google for the *APA Citation Style Guide or the Chicago Manual of Style Citation Guide.*

## Examples of Plagiarism and Paraphrasing

The original text:

"“The new Internet economy has brought about the development of competing search engine companies, each with its own proprietary software. Sites are collected and updated differently. After a search is conducted, one search engine provides exactly what’s required within the first ten hits whereas another is useless. Frequently there is tremendous overlap, although no two search engines are exactly alike. Since the outcome varies from search engine to search engine, researchers often find it necessary to use several engines for the same question for either the best or more comprehensive results.”" Burnett, Rebecca E. (2001). *Technical Communication (5th ed.).* Fort Worth: Harcourt, Inc., p. 199.

Read the following examples and decide if each is an example of acceptable paraphrasing or of plagiarism.

1. Burnett points out that competing search engine companies have proprietary software that collects and updates sites differently. As a result, one will provide what you want within the first ten hits, while another is useless. That means that researchers will frequently need to use several engines to obtain the best or more comprehensive answers (*2001*).
2. Multiple search engines on the Internet have arisen, each with unique strengths and weaknesses. These differences derive from each engine’s respective method of analyzing and classifying information on the Internet. As a direct result of these differences, more exhaustive search results are often obtained through the use of several engines (*Burnett 2001*).

3. When researching a specific subject on the Internet, the use of multiple search engines is essential for a thorough search because each search engine utilizes different algorithms.
4. Rebecca Burnett suggests that we use several search engines because sometimes there is tremendous overlap in results and the outcome differs from search engine to search engine (*2001*).

**Answers to the above 4 responses, which were all written by students who thought they were paraphrasing. Only one succeeded.**

1. Even though the author's name and date are cited, **this is clearly plagiarism**. Changing the verb from passive to active ("are collected and updated differently" becomes "collects and updates differently") is not sufficient change. Substituting "while" for "whereas" in "within the first ten hits …another is useless" again is not sufficient change. Some exact wording is retained; sentence structure is identical. The same objections hold for "to use several engines …. The best or more comprehensive answers."Some students have tried to argue that the information in the original paragraph is now common knowledge and that, as a result, some use of the exact wording is inevitable. I agree, to a certain extent. I wouldn't be surprised if "proprietary software" occurred to many writers as a phrase. But example #1 relies far too heavily on simple substitution while retaining sentence structure and whole blocks of words.
2. This is a **fine paraphrase**. The source is cited and the only duplicate wording occurs in "several engines," a phrase that I would agree is in common use and therefore is **not plagiarism.**
3. This is an acceptable paraphrase, but the source is not cited. **So it is plagiarism!**
4. Because this is so short, you might be tempted to call is a paraphrase. But "tremendous overlap" is identical, and "the outcome differs from search engine to search engine" changes only "varies" to "differs" and leaves the rest of the wording and structure the same. **It is plagiarism.**

## Frequently asked questions

**When don’t I have to cite the source for information?**

You don’t have to cite basic knowledge that is found in two or more textbooks. But neither can you use it word for word—you must paraphrase. The exception would be something like a common formula or algorithm; those you would have to use as they appear in the source.

**What if I’m using a common method that’s difficult to reword? Do I have to cite the source?**

If you use it word for word rather than paraphrasing it, you must cite the source. I know of an Assistant Professor who was denied tenure for taking a method word for word from a published paper.

**How do I cite a source that I read about in a different article, a review article, for example?**

You will have to cite the source as well as the review article. It’s always best to get a copy of the original article instead of relying on what someone else says about it. Reviewers are not equally good, and even a good reviewer may be focusing on different aspects of the article than you need. The exception would be an article originally published in a language you can’t read or an article that is no longer available. In such cases you must make clear that it is the reviewer’s interpretation that you are citing.

**What do I put in the Bibliography?**

Everything you cited and nothing that you didn’t cite.

**What should I do if I have an important quotation or a really relevant Figure, but I can’t remember where I found them?**

See if you can track it down via the Internet. If you can't find it, you can't use it.

**Can I cite my own previously published paper or my thesis in a paper I'm submitting for publication?**

Of course! Keep in mind, though, that every author listed on a published paper has equal copyright ownership and can also cite the paper. Being first author does not give you sole ownership. If you were first author and are now using essentially the entire paper as a chapter in your Master's or PhD thesis, make clear at the outset of the chapter that it comes largely from your paper (cite it clearly!). Then later in the chapter make it absolutely clear that the chapter is based on your paper. If you use any figures or tables from the published paper, cite those as well. If you are using your thesis as the basis for a paper, make that clear, too. You can cite it as an unpublished thesis or dissertation.

**When do I have to get permission to quote or paraphrase something?**

In the academic world, this is sometimes a gray area. You usually don't have to get permission for use if you are writing a paper for a class, a Master's thesis, or a PhD dissertation, though you must cite the source. And because being cited helps faculty receive tenure or academic awards, most researchers are delighted to be cited in academic journals. Journals may have guidelines, though, so be sure to check. The issue becomes less clear if your paper is chosen to be published in a Proceedings; you may well have to get permission for use there. Check with the editors. And if you publish a book, you will almost certainly need to get permission from the author. Keep a paper copy of your request and a paper copy of the reply. If your paper comes out of funded research, you may need permission to publish what might otherwise be considered the intellectual property of the funding agency.

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Copyright and Electronic Publishing: Citation

## Basic Information

- The copyright protections associated with print also govern the use of audio, video, images, and text on the World Wide Web (WWW).
- If a document is on the WWW, that DOES NOT mean that it is in the public domain and may be used with no restrictions.
- A document on the WWW may be copyrighted even if it does not explicitly state that it is copyrighted. Assume that a work is copyrighted unless the site explicitly authorizes use.
- The same copyright protections exist for the author of a work regardless of whether the work is in a database, CD, discussion board, blog, or web page.
- Cite a visual used in the text at the end of the Figure or Table caption: (*Ozymandias 2005*) just as you would cite text in a paragraph. If you use only part of a visual or change it, cite it as (*Adapted from Ozymandias 2005*).
- Put all electronic citations in your Bibliography or Works Cited.

## Tips on Using Internet Resources

- ALWAYS credit the source of your information.
- Check to see if the author provides information on how his/her work (e.g., video, audio, graphic, icon, web page) may be used. Make sure to follow the guidelines, if they exist.
- If possible, ask the owner of the copyright for permission to use the work. Because all authors of a single document have equal copyright protection, it is necessary to get permission from only one. The corresponding author of a paper should be your first choice. Keep a paper copy of your request for permission and of the permission received.
- If you use one of your own published articles in your thesis, you don’t need permission from the other authors, all of whom have equal copyright rights. Clearly state the source, however, and recognize the contributions of the other authors. Most journals will give you

permission to use your published paper in your thesis, but check the contract!
- If you post a chapter from your unfinished thesis or a paper you plan to submit for publication, it is considered published and copyrighted by the act of placing it on the Internet. A journal then cannot accept it for publication because it has already been published. To avoid this copyright disaster, clearly label the posted material as DRAFT and make certain that it differs from what you later submit as finished thesis or paper for publication.

## Guidelines for Citing Electronic Media

Check with the journal, your advisor, or your professor to determine what style is required. The APA style guide and the Chicago Manual of Style are commonly used, but some journals have their own style sheets. If you are submitting for publication outside the U.S., style expectations will differ. Preferred style may differ from field to field, as well. If you have kept accurate and complete notes on what you read, you'll be able to meet any requirements.

### What to Include (if available)

- Name of the author, editor, compiler, or translator of the document or graphic. Last name, First initial. (Make this complete enough so that you can do an electronic search for it. Sometimes last name and first initial are not sufficient, as in "Jones, J.")
- Date of document's publication or last update on the Web site. If the publication date is not known, use n.d. to indicate "no date" (n.d.).
- Title of the document, graphic, or the Web Site.
- Publication information--the name of the main Web Site where the document or graphic is posted.
- Page number range or total number of pages or other sections, if they are numbered.
- Date accessed and location of the material on that date: Month, day, year; URL.

- Keep a paper copy to prove the date accessed to protect yourself if it disappears from the Web.
- If you download an article published as print, you may cite it as a printed source. If you cite an article in an electronic journal, you must cite it as a Web source.

## Examples of Citation in a Bibliography or Works Cited

Notice that the same basic information is included in the three entries for journal articles, although the styles differ. Choose the style appropriate for what you are writing, and then be consistent within the document. You must follow a style guide.

If the Bibliography is set up numerically rather than alphabetically, as would happen when references are numbered consecutively within a text, the entries would be numbered and the authors' names would all be first name first, as in [1] *Christopher Beattie, Mark Embree, etc.*

**Print sources**

Beattie, Christopher, Mark Embree, and D. C. Sorensen. Convergence of Polynomial Restart Krylov Methods for Eigenvalue Computation. *SIAM Rev.*, 47 (2005), pp. 492-515. [Journal style]

Chen, J. Y., A. Kutana, C. P. Collier, and K.P. Giapis. Electrowetting in Carbon Nanotubes. *Science 310*, 1480-1483 (2005). [Journal style]

Hacker, Diana. (2006). *The Bedford Handbook*. Boston and New York: Bedford/St. Martin's. [APA style]

Nicolo, Micah J., Gerald R. Dickens, Christopher J. Hollis, and James C. Zachos. "Multiple early Eocene hyperthermals: Their sedimentary expression on the New Zealand continental margin and in the deep sea," Geology 35, no. 8 (2007): 699-702. [Chicago style]

**Electronic sources**

Herbst, Roy S., M.D., PhD., and Scott M. Lippman, M.D. Molecular Signatures of Lung Cancer—Toward Personalized Therapy. *New England Journal of Medicine 356*, no. 1 (January 4, 2007): 76-78. Retrieved April 18, 2007 from http://www.nejm.org

Ortiz-Barrientos, D. and M. A. F. Noor. Evidence for a One-Allele Assortative Mating Locus." Science 310, no. 5753 (2005): 1467. Retrieved September 1, 2007 from http://www.sciencemag.org

Provenzo, Eugene F. Jr. "Time Exposure." Educational Studies 34, no. 2 (2003): 266-67. Retrieved September 11, 2007 from http://search.epnet.com

**Additional Resources**

See http://www.bitlaw.com/ (Gives information about copyright laws.)

Visit http://www.apastyle.org/elecsource.html#72 (Extensive examples of how to cite journal articles in APA format, the form used by many fields.)

# Discipline- or Field-Specific Graduate Course Communication Resources

Although graduate students may have studied communication in their undergraduate programs, their advanced courses may introduce types of reports, such as literature reviews or presentations of published articles that are uncommon in undergraduate courses. The materials listed below offer brief but salient advice on how to succeed with such assignments.

- Advanced Biomechanics Teaching Project(Bioengineering)
- Communicating Ethically
- Copyright and Electronic Publishing: Citation
- Demonstrating Your Knowledge and Contributions to a Profession
- How to Read a Scientific Article
- How to Read a Scientific Article with Civil Engineering Example (Civil Engineering)
- Presenting a Technology Analysis (Computer Science)
- Questions That Matter in an Internship Report
- Recognizing and Avoiding Plagiarism
- Sample Executive Summary for an Internship Report to Managers
- Seven Ways to Motivate the Audience
- Template for Taking Notes on Research Articles: Easy access for later use

You may also wish to consult more general resources on communication:

- Group or Team Communication Resources
- Speaking and Oral Presentations Resources
- Writing Resources
- Visual Design, Poster, and PowerPoint Resources

You may possibly wish to search for

- Discipline- or Field-Specific Undergraduate Course Communication Resources
- Communication Evaluation and Planning Forms
- Communication Teaching Resources: Assignments and Materials to Use in Class

- Communication Teaching Resources: Integrating Communication Instruction into Courses
- Communication Teaching Resources: Training Materials for Student Communication Mentors, Coaches, and Discussion Leaders
- Resources for Professional Development and Communication
- Resources on Thesis and Dissertation Preparation for Graduate Students

**The preparation of these materials was funded through a generous grant from the Gordon and Mary Cain Foundation.**

Discipline- or Field-Specific Undergraduate Course Communication Resources

Writing, presenting, discussion, and making posters can help students understand key course concepts or apply them to specific circumstances. While working with faculty in the schools of engineering and natural sciences at Rice University, instructors from the Cain Project in Engineering and Professional Communication have prepared assignments and supporting materials for communication instructions appropriate to specific fields. Some of these materials also explain techniques or situations that will be common in a specific field, such as designing legible graphics with software packaged, MATLAB, used in Chemical Engineering.

The materials listed below were designed for courses in specific departments, but they may be relevant to other courses as well. You may look for your own field in the grouped materials, but be sure to consider those labeled "general" or "professional" as well.

## General

- A Brief Introduction to Technical Style
- A Guide to Writing a Recommendation Report
- Basics of Negotiating: Based on the Harvard Negotiation Project Principles
- Communicating Ethically
- Displaying Data in Written Documents
- Exercises in Evaluating Word Density in Slides
- Giving Feedback on Students' PowerPoints
- Good Design in PowerPoint
- Group Leader Handbook
- Graphics Evaluation Form
- How to Read a Scientific Article
- How to Consult with a Writing Mentor: OWL-Space Scheduling
- How to Work with Presentations Coaches
- How to Work with Writing Mentors
- In-House Memo Reports Reporting to Colleagues
- Instructions for Using Calibrated Peer Review

- Literature Review Introduction Sample
- Managing Conflict in Teams: Switching to Successful Negotiation
- Organizing an Analysis for a Review of Published Literature
- Organizing an Argument for a Literature Review
- Preparing and Delivering Oral Presentations
- Presenting a Failure Analysis
- Presenting a Technology Analysis
- Recognizing and Avoiding Plagiarism
- Rules for the Use of Numbers in Scientific Writing
- Sample Chemical Engineering Student Team PowerPoint for Analysis
- Seven Ways to Motivate the Audience
- Test Whether Your Poster Can Stand Alone
- Working in Teams: A Brief Introduction
- Writing Mentors

## Professional

- Communicating in Non-routine Situations
- Dealing with Routine Situations
- Guide to Communication and Corporate Culture
- Presenting to Managers and Other Professionals
- The Business Climate for Engineering Communication

## Science and Engineering

### Bioengineering

- An Exercise in Evaluating Photo Backgrounds in Slides
- Course Project: The Costs and Benefits of Building “Green" (Chemical and Biomolecular Engineering)
- CPR Questions for Poster Module
- Instructions for Using Calibrated Peer Review
- Poster Draft from Bioengineering’s Capstone Design Course (1)
- Poster Draft from Bioengineering’s Capstone Design Course (2)
- Poster Evaluation Form (Bioengineering Poster Assignment)

- Poster Summarizing Results from HDF Survival and Function in vitro (Poster Assignment in Bioengineering)
- SmartWhistle Poster Draft from Bioengineering's Capstone Design Course
- Team Presentations in Chemical and Biomolecular Engineering
- Write an Application Letter that Lands a Bioengineering Internship

**Civil and Environmental Engineering**

- An Introduction to Civil and Environmental Engineering Communication Materials
- Evaluation Sheet for Project Presentations
- Group Paper Assignment
- Group Paper Proposal Assignment
- Guide for Team Presentations
- Literature Review Introduction Sample
- Managing Conflict in Teams: Switching to Successful Negotiation
- Organizing an Analysis for a Review of Published Literature
- Organizing an Argument for a Literature Review
- Project Proposal Evaluation Form
- Sample Proposal #1
- Sample Proposal #2

**Other**

- An Exercise in Evaluating Photo Backgrounds in Slides(Biosciences)
- Assignment: Central Plant Flow Meter Report (Mechanical Engineering)
- Project Assignment: Analysis of Algorithms and Data Structures (Computer Science)
- Sample Chemical Engineering Student Team PowerPoint for Analysis (Chemical Engineering)
- Writing Assignment: Indian Ocean Earthquake and Tsunami(Earth Science)

You may also wish to consult more general resources on communication:

- Group or Team Communication Resources
- Speaking and Oral Presentations Resources
- Writing Resources
- Visual Design, Poster, and PowerPoint Resources

You may possibly wish to search for

- Discipline- or Field-Specific Graduate Course Communication Resources
- Communication Evaluation and Planning Forms
- Communication Teaching Resources: Assignments and Materials to Use in Class
- Communication Teaching Resources: Integrating Communication Instruction into Courses
- Communication Teaching Resources: Training Materials for Student Communication Mentors, Coaches, and Discussion Leaders
- Resources for Professional Development and Communication
- Resources on Thesis and Dissertation Preparation for Graduate Students

The preparation of these materials was funded through a generous grant from the Gordon and Mary Cain Foundation.

How to Read a Scientific Article

Reading a scientific article is a complex task. The **worst** way to approach this task is to treat it like the reading of a textbook—reading from title to literature cited, digesting every word along the way without any reflection or criticism. Rather, you should begin by skimming the article to identify its structure and features. As you read, look for the author's main points. Generate questions before, during, and after reading. Draw inferences based on your own experiences and knowledge. And to really improve understanding and recall, take notes as you read. This handout discusses each of these strategies in more detail.

## Skim the article and identify its structure

Most journals use a conventional IMRD structure: An abstract followed by Introduction, Methods, Results, and Discussion. Each of these sections normally contains easily recognized conventional features, and if you read with an anticipation of these features, you will read an article more quickly and comprehend more.

### Features of Abstracts

Abstracts usually contain four kinds of information:

- purpose or rationale of study (why they did it)
- methodology (how they did it)
- results (what they found)
- conclusion (what it means)

Most scientists read the abstract first. Others—especially experts in the field—skip right from the title to the visuals because the visuals, in many cases, tell the reader what kinds of experiments were done and what results were obtained. You should probably begin reading a paper by reading the abstract carefully and noting the four kinds of information outlined above. Then move first to the visuals and then to the rest of the paper.

## Features of Introductions

Introductions serve two purposes: creating readers' interest in the subject and providing them with enough information to understand the article. Generally, introductions accomplish this by leading readers from broad information (what is **known** about the topic) to more specific information (what is **not known**) to a focal point (what **question** the authors asked and answered). Thus, authors describe previous work that led to current understanding of the topic (the broad) and then situate their work (the specific) within the field.

## Features of Methods

The Methods section tells the reader what experiments were done to answer the question stated in the Introduction. Methods are often difficult to read, especially for graduate students, because of technical language and a level of detail sufficient for another trained scientist to repeat the experiments. However, you can more fully understand the design of the experiments and evaluate their validity by reading the Methods section carefully.

## Features of Results and Discussion

The Results section contains results—statements of what was found, and reference to the data shown in visuals (figures and tables). Normally, authors do not include information that would need to be referenced, such as comparison to others' results. Instead, that material is placed in the Discussion—placing the work in context of the broader field. The Discussion also functions to provide a clear answer to the question posed in the Introduction and to explain how the results support that conclusion.

## Atypical Structure

Some articles you read will deviate from the conventional content of IMRD sections. For instance, Letters to Nature appear to begin with an abstract, followed by the body of the article. Upon reading, however, you will see that the “abstract” is a summary of the work filled with extensive introduction (for the purpose of catching the attention of a wide audience), and the next paragraph begins a description of the experiments.

Therefore, when you begin to read an article for the first time, skim the article to analyze the document as a whole. Are the sections labeled with headings that identify the structure? If not, note what the structure is. Decide which sections contain the material most essential to your understanding of the article. Then decide the order in which you will read the sections.

## Distinguish main points

Because articles contain so much information, it may be difficult to distinguish the main points of an article from the subordinate points. Fortunately, there are many indicators of the author’s main points:

### Document level

- Title
- Abstract
- Keywords
- Visuals (especially figure and table titles)
- First sentence or the last 1-2 sentences of the Introduction

### Paragraph level: words or phrases to look for

- surprising
- unexpected
- in contrast with previous work
- has seldom been addressed

- we hypothesize that
- we propose
- we introduce
- we develop
- the data suggest

## Generate questions and be aware of your understanding

Reading is an active task. Before and during your reading, ask yourself these questions:

- Who are these authors? What journal is this? Might I question the credibility of the work?
- Have I taken the time to understand all the terminology?
- Have I gone back to read an article or review that would help me understand this work better?
- Am I spending too much time reading the less important parts of this article?
- Is there someone I can talk to about confusing parts of this article?

After reading, ask yourself these questions:

- What specific problem does this research address? Why is it important?
- Is the method used a good one? The best one?
- What are the specific findings? Am I able to summarize them in one or two sentences?
- Are the findings supported by persuasive evidence?
- Is there an alternative interpretation of the data that the author did not address?
- How are the findings unique/new/unusual or supportive of other work in the field?
- How do these results relate to the work I’m interested in? To other work I’ve read about?
- What are some of the specific applications of the ideas presented here? What are some further experiments that would answer remaining questions?

## Draw inferences

Not everything that you learn from an article is stated explicitly. As you read, rely on your prior knowledge and world experience, as well as the background provided in the article, to draw inferences from the material. Research has shown that readers who actively draw inferences are better able to understand and recall information.

As an example, in the box below is an excerpt from the Introduction of an article in the journal *Biochemistry (Ballestar et al., 2000).* The comments in italics are questions and inferences that might be drawn by a student reader.

**Example:**
Rett Syndrome is a childhood neurodevelopmental disorder and one of the most common causes of mental retardation in females **Comment: Hmmm…must be related to a gene on the X-chromosome,** with an incidence of 1 in 10000-15000. **Comment: How common is that? Not too likely to happen to me, but there must be several such children born in Houston every year.** Rett syndrome patients are characterized by a period of normal growth and development (6-18 months) followed by regression with loss of speech and purposeful hand use. **Comment: What happens? Something must be triggered or activated at late infancy.** Patients also develop seizures, autism, and ataxia. After initial regression, the condition stabilizes and patients survive into adulthood. Studies of familial cases provided evidence that Rett is caused by X-linked dominant mutations in a gene subject to X-chromosome inactivation. Recently, a number of mutations in the gene encoding the methyl-CpG binding transcriptional repressor MeCP2 have been associated with Rett Syndrome. **Comment: MeCP2 mutations probably cause Rett Syndrome. This must be an important master-regulator to affect so many processes in the brain. I wonder what they know about it…**

## Take notes as you read.

Effective readers take notes—it improves recall and comprehension. You may think you'll remember everything you read in researching class assignments, professional papers, proposals, or your thesis, but details will slip away. Develop a template for recording notes on articles you read, or adapt the template below for use. As you accumulate a large collection of articles, this template will help you distinguish articles and quickly locate the correct reference for your own writing. The time spent filling out the form will save you hours of rereading when you write a Background, Related Work, or a Literature Review section.

**Example:**

**Template for Taking Notes on Research Articles: Easy access for later use**

Whenever you read an article, pertinent book chapter, or research on the web, use the following format (or something similar) to make an electronic record of your notes for later easy access. Put quotation marks around any exact wording you write down so that you can avoid accidental plagiarism when you later cite the article.

Complete citation. Author(s), Date of publication, Title (book or article), Journal, Volume #, Issue #, pages:
If web access: url; date accessed
Key Words:
General subject:
Specific subject:
Hypothesis:
Methodology:
Result(s):
Summary of key points:
Context (how this article relates to other work in the field; how it ties in with key issues and findings by others, including yourself):
Significance (to the field; in relation to your own work):
Important Figures and/or Tables (brief description; page number):
Cited References to follow up on (cite those obviously related to your topic AND any papers frequently cited by others because those works may well prove to be essential as you develop your own work):

Other Comments:

How to Read a Scientific Article with Civil Engineering Example

Reading a scientific article is a complex task. The **worst** way to approach this task is to treat it like the reading of a textbook—reading from title to literature cited, digesting every word along the way without any reflection or criticism. Rather, you should begin by skimming the article to identify its structure and features. As you read, look for the author's main points. Generate questions before, during, and after reading. Draw inferences based on your own experiences and knowledge. And to really improve understanding and recall, take notes as you read. This handout discusses each of these strategies in more detail.

## Skim the article and identify its structure

Most journals use a conventional IMRD structure: An abstract followed by Introduction, Methods, Results, and Discussion. Each of these sections normally contains easily recognized conventional features, and if you read with an anticipation of these features, you will read an article more quickly and comprehend more.

### Features of Abstracts

Abstracts usually contain four kinds of information:

- purpose or rationale of study (why they did it)
- methodology (how they did it)
- results (what they found)
- conclusion (what it means)

Most scientists read the abstract first. Others—especially experts in the field—skip right from the title to the visuals because the visuals, in many cases, tell the reader what kinds of experiments were done and what results were obtained. You should probably begin reading a paper by reading the abstract carefully and noting the four kinds of information outlined above. Then move first to the visuals and then to the rest of the paper.

## Features of Introductions

Introductions serve two purposes: creating readers' interest in the subject and providing them with enough information to understand the article. Generally, introductions accomplish this by leading readers from broad information (what is **known** about the topic) to more specific information (what is **not known**) to a focal point (what **question** the authors asked and answered). Thus, authors describe previous work that led to current understanding of the topic (the broad) and then situate their work (the specific) within the field.

## Features of Methods

The Methods section tells the reader what experiments were done to answer the question stated in the Introduction. Methods are often difficult to read because of technical language and a level of detail sufficient for another trained scientist to repeat the experiments. However, you can more fully understand the design of the experiments and evaluate their validity by reading the Methods section carefully.

## Features of Results and Discussion

The Results section contains results—statements of what was found, and reference to the data shown in visuals (figures and tables). Normally, authors do not include information that would need to be referenced, such as comparison to others' results. Instead, that material is placed in the Discussion—placing the work in context of the broader field. The Discussion also functions to provide a clear answer to the question posed in the Introduction and to explain how the results support that conclusion.

## Atypical Structure

Some articles you read will deviate from the conventional content of IMRD sections. Therefore, when you begin to read an article for the first time, skim the article to analyze the document as a whole. Are the sections labeled with headings that identify the structure? If not, note what the structure is. Decide which sections contain the material most essential to your understanding of the article. Then decide the order in which you will read the sections.

## Distinguish main points

Because articles contain so much information, it may be difficult to distinguish the **main points** of an article from the **subordinate points**. Fortunately, many indicators signal the location of the author's main points. The placement of information and the words chosen to convey information can help readers decipher the main points. Look in these places:

### Document level

- Title
- Abstract
- Keywords
- Visuals (especially figure and table titles)
- First sentence or the last 1-2 sentences of the Introduction

### Paragraph level: words or phrases to look for

- surprising
- unexpected
- in contrast with previous work
- has seldom been addressed
- we hypothesize that
- we propose
- we introduce
- we develop

- the data suggest

## Generate questions and be aware of your understanding

Reading is an active task. Before and during your reading, ask yourself these questions:

- Who are these authors? What journal is this? Might I question the credibility of the work?
- Have I taken the time to understand all the terminology?
- Have I gone back to read an article or review that would help me understand this work better?
- Am I spending too much time reading the less important parts of this article?
- Is there someone I can talk to about confusing parts of this article?

After reading, ask yourself these questions:

- What specific problem does this research address? Why is it important?
- Is the method used a good one? The best one?
- What are the specific findings? Am I able to summarize them in one or two sentences?
- Are the findings supported by persuasive evidence?
- Is there an alternative interpretation of the data that the author did not address?
- How are the findings unique/new/unusual or supportive of other work in the field?
- How do these results relate to the work I'm interested in? To other work I've read about?
- What are some of the specific applications of the ideas presented here? What are some further experiments that would answer remaining questions?

## Draw inferences

Not everything that you learn from an article is stated explicitly. As you read, rely on your prior knowledge and world experience, as well as the background provided in the article, to draw inferences from the material. Research has shown that readers who actively draw inferences are better able to understand and recall information.

As an example, in the box below is an excerpt from the introduction of an article in the book *Solutions to Coastal Disasters (J. H. Jensen, 2000).* The comments in italics are questions and inferences that might be drawn by a student reader.

**Example:**
On an exposed sandy beach, coastal impacts and sedimentation are important aspects in the optimization of a harbor layout. **Comment: Hmmm…must be related to where to place structures . . ..,** Hanstholm harbor on the West Coast of Denmark is an example of a very successful harbor located near a headland on an exposed coastline. **Comment: I've never been there, but I wonder if it's like the harbors around the Massachusetts coast?** The harbor is a fishery and ferry port originally designed by Professor Helge Lundgren and was built in the 1960s at a critical location with about 0.4 million m3/year net northward transport and a gross transport of around 1.5 million m3/year. The symmetrical and streamlined layout creates a smooth convergence of the flow past the harbor entrance and has in combination with vertical breakwaters resulted in acceptable sedimentation rates both updrift of the entrance and within the outer harbor. **Comment: What happens? Something about symmetry and flow must be important. Must have involved calculating sedimentation rates. They must be the test of whether a design is good.** The sedimentation is localized in the outer harbor immediately inside the entrance, and a natural depth in the entrance area is about 9 m. The average yearly sedimentation in the harbor is 80,000 m3. The flow around Hanstholm harbor is mainly driven by meteorological forcing, variations in wind and pressure, and, to a less extent, by wave breaking. **Comment: If tide is limited, what factors will be important in the extension? What's the problem going to be? What will have to be optimized now?. . .**

## Take notes as you read.

Effective readers take notes—it improves recall and comprehension. You may think you'll remember everything you read in researching class assignments, professional papers, proposals, or your thesis, but details will slip away. Develop a template for recording notes on articles you read, or adapt the template below for use. As you accumulate a large collection of articles, this template will help you distinguish articles and quickly locate the correct reference for your own writing. The time spent filling out the form will save you hours of rereading when you write a Background, Related Work, or a Literature Review section.

**Example:**
**Template for Taking Notes on Research Articles: Easy access for later use**
Whenever you read an article, pertinent book chapter, or research on the web, use the following format (or something similar) to make an electronic record of your notes for later easy access. Put quotation marks around any exact wording you write down so that you can avoid accidental plagiarism when you later cite the article.
Complete citation. Author(s), Date of publication, Title (book or article), Journal, Volume #, Issue #, pages:
If web access: url; date accessed
Key Words:
General subject:
Specific subject:
Hypothesis:
Methodology:
Result(s):
Summary of key points:
Context (how this article relates to other work in the field; how it ties in with key issues and findings by others, including yourself):
Significance (to the field; in relation to your own work):
Important Figures and/or Tables (brief description; page number):

Cited References to follow up on (cite those obviously related to your topic AND any papers frequently cited by others because those works may well prove to be essential as you develop your own work):
Other Comments: